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RELATIVE ABUNDANCE OF MICE ON SEEDED SAGEBRUSH-GRASS RANGE IN RELATION TO GRAZING

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ABSTRACT

The kinds and relative abundance of small rodents were studied in relation to various kinds of grasses and different intensities of grazing by cattle. Deer mice, Great Basin pocket mice and western harvest mice comprised over 98 percent of the total catch. Deer mice were most abundant in heavily grazed seeded areas and native areas having relatively light cover. Great Basin pocket mice and western harvest mice were most abundant in areas of relatively light grazing. No definite correlation was found between relative abundance of any rodent and species of grass.

Sagebrush-grass vegetation has been greatly modified by man and his animals in the Intermountain region. Some abortive attempts at dryland farming resulted in a considerable amount of abandoned land by the early 1930's. Also, heavy grazing by livestock in both spring and fall contributed to depletion of vast areas in this zone situated mainly between the higher summer ranges and the lower salt desert shrub winter ranges. Fortunately, many abandoned and depleted areas have been rehabilitated by seeding with adapted grasses. The effects of such modifications and subsequent grazing by livestock on small mammals are not well known. This paper reports results of a study designed to determine the kinds and numbers of rodents present in relation to various kinds of grasses and different intensities of grazing by cattle.

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This study was conducted during summer and early fall of 1966 and 1967 on the Benmore Experimental Range in southeastern Tooele County, Utah, which is typical of much improved spring-fall range in the Intermountain region. Elevations of the area range from 1,700 to 1,890 m. (5,600 to 6,200 ft.). Annual precipitation is approximately 33 cm. (13 in.). Originally, the experimental area was part of the natural sagebrush-grass community bordering the lower edge of the pinyon-juniper. Modifications of the area by man have produced a sizable number of pastures for grazing of livestock, 15 of which were involved in this study as follows: (1) 8 units, heavily grazed, that had been fenced from abandoned dry-farm land and seeded in 1939 to crested wheatgrass (*Agropyron desertorum* [Fisch.] Schult.) and fairway wheatgrass (*A. cristatum* [L.] Gaertn); (2) 5 units, moderately grazed, that had been plowed, fenced and seeded to different introduced grasses in 1949; and (3) 2 units, ungrazed, containing native species, one of the units also having been interseeded with a mixture of introduced grasses following burning of both areas in 1953.

METHODS

In the study, short term removal-trapping was accomplished by using snap traps for three consecutive nights in both early summer and early fall of 1966 and 1967. Museum special and standard mousetraps were set in three concentric circles having radii of 11.95 m. (39.2 ft.), 23.93 m. (78.5 ft.), and 35.91 m. (117.8 ft.), respectively, from a common center. The outer circle enclosed an area of 0.4047 ha. (1 acre). Twenty-four traps were set on the outer circle, 16 on the middle, and 8 on the inner circle, making a total of 48 traps per acre. The distance between traps along the circumference of each circle was approximately 9.45 m. (31 ft.). Two 1-acre plots were sampled in each of the 15 pastures.

Traps were baited each night before dark using a peanut-butter and rolled-oats mixture. With few exceptions, traps were checked and set off each morning prior to 8 a.m. to prevent catching unwanted species such as birds.

RESULTS

Over the two years, a total of 17,280 trap nights yielded 587 rodents. Three species comprised over 98 percent of the total catch as follows: deer mouse (*Peromyscus maniculatus sonoriensis* Le Conte), 65.5%; western harvest mouse (*Reithrodontomys megalotis megalotis* Baird), 19.0%; and Great Basin pocket mouse (*Perognathus parvus olivaceous* Merriam), 14.3%. In addition to these major species, three grasshopper mice (*Onychomys leucogaster utahensis* Goldman) were caught during this study, plus one each of the following species: chisel-toothed kangaroo rat (*Dipodomys microps bonnevillei* Goldman), pinon mouse (*Peromyscus truei nevadensis* Hall and Hoffmeister), desert wood rat (*Neotoma lepida lepida* Thomas), long-tailed meadow mouse (*Microtus longicaudus latus* Hall), and house mouse (*Mus musculus domesticus* Rutty). Subsequent discussion involves only the three most abundant species.

Heavily Grazed Units

The eight units grazed heavily by cattle in early spring (April 20 to May 20) prior to trapping in both 1966 and 1967 had been grazed at different seasons during the previous 5 years. As a result (prior to 1966), five of these units contained a considerable amount of old, dry, standing grass resulting from grazing after maturity in summer or fall. Little or no dry grass occurred in the three units that had been grazed in spring previous to our trapping study. Under heavy stocking in the five units in the spring of 1966, cattle ate a small amount of the old, dry grass, the remainder being dispersed on the ground as litter. Generally, fairway wheatgrass produced less litter than crested wheatgrass.

In the heavily grazed units, deer mice were caught most often of any species in both years of trapping (table 1). Pocket mice were never abundant in these units but were taken quite consistently. Their relatively small numbers appeared unrelated to season or year of trapping. Harvest mice were caught least consistently of the three species; the first year they were caught mostly in localized areas where either grass or brush, or both, were most dense, and none were caught the second year. Whereas numbers of both deer mice and harvest mice increased between early summer and fall trappings in 1966, this was not the case in 1967.

Apparently, old grass litter left lying on the ground in certain units following heavy spring grazing in 1966 had little effect, if any, on numbers of mice present (table 1). If differences due to past grazing existed prior to 1966, they were erased by the heavy spring grazing that year. There were no consistent differences between crested and fairway wheatgrasses as to number of mice trapped.

Table 1.--*Numbers of three mice species caught in eight heavily grazed units according to season of past grazing by cattle*

Season of past grazing	Deer mice				Pocket mice				Harvest mice			
	1966		1967		1966		1967		1966		1967	
	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall
Spring:												
Agcr[1]	0	22	2	8	0	2	0	1	0	2	0	0
Agde[2]	4	6	6	4	2	1	2	1	0	0	0	0
Summer:												
Agcr	2	18	3	3	1	0	0	1	0	0	0	0
Agde	4	31	1	3	2	2	1	2	1	4	0	0
Fall:												
Agcr	7	29	0	1	1	2	2	0	0	1	0	0
Agde	3	17	4	3	0	1	0	0	0	3	0	0
Spring + Fall:												
Agde	4	38	5	1	1	0	0	0	1	2	0	0
Summer (Brush):												
Agde	0	29	0	4	0	1	0	0	0	2	0	0

[1]*Agropyron cristatum.*
[2]*Agropyron desertorum.*

Moderately Grazed Units

The five moderately grazed units contained individual stands of crested wheatgrass, pubescent wheatgrass (*A. trichophorum* [Link] Richt.), intermediate wheatgrass (*A. intermedium* [Host] Beauv.), Russian wildrye (*Elymus junceus* Fisch.), and a mixture of the first three grasses plus tall wheatgrass (*A. elongatum* [Host] Beauv.). These units were ungrazed prior to the first trapping in early summer of 1966, but were grazed moderately prior to the second trapping in fall of 1966 and again prior to first trapping in early summer 1967. They had been grazed moderately by cattle for several years, and during this study considerably more dry, standing grass was present in each of them than in the heavily grazed units described earlier (fig.1).

Figure 1.--Typical heavily grazed crested wheatgrass unit at left, contains less dry grass than moderately grazed pubescent wheatgrass at right.

Table 2.--*Numbers of three mice species in moderately grazed units, according to kind of grass*

Grass species	Deer mice				Pocket mice				Harvest mice			
	1966		1967		1966		1967		1966		1967	
	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall
Pubescent wheatgrass	3	24	3	1	0	3	0	0	13	7	0	0
Intermediate wheatgrass	0	5	3	0	2	1	1	0	0	2	0	0
Wheatgrass mixture	1	6	0	2	1	0	0	1	5	4	0	0
Crested wheatgrass	0	6	2	2	2	6	1	1	9	8	0	0
Russian wildrye	1	11	0	1	3	3	4	1	2	0	0	0

During the early summer trapping of 1966, harvest mice were the most numerous species in the moderately grazed units (table 2). Their greater abundance in pubescent and crested wheatgrasses coincided with greater volumes of dry, standing grass. Although harvest mice showed an overall decline at time of fall trapping, deer mice had increased substantially and pocket mice slightly. By early summer of 1967, numbers of deer mice and pocket mice had characteristically returned to the approximate levels shown for the same period in 1966, and again, no harvest mice were caught. Possible reasons for numbers remaining relatively low through the fall trapping period of 1967 are discussed later.

Nongrazed Units

The two units containing native grasses that had never been plowed were essentially ungrazed by livestock during this study. On one unit a mixture of crested, intermediate, and tall wheatgrasses had been seeded into the native remnant following burning of sagebrush in 1953; this unit contained more dry, standing grass than any unit during this study (fig. 2). Much less dry grass occurred on the adjacent unit containing mainly native thickspike wheatgrass (*Agropyron dasystachyum* [Hook.] Scribn.), bluebunch wheatgrass (*A. spicatum* [Pursh] Scribn. & Smith), Sandberg bluegrass (*Poa secunda* Presl.), and bottlebrush squirreltail (*Sitanion hystrix* [Nutt.] J. G. Smith).

Striking contrast existed in the mice catches on these two areas (table 3). Deer mice were most abundant in the unit of relatively short cover containing only native plants, but harvest mice were most abundant in the unit of tall cover having a mixture of native and introduced species.

Figure 2.--Mixture of introduced and native grasses at left provides denser cover for mice than area at right which contains only native species.

Table 3.--*Numbers of three mice species in nongrazed units in relation to kind of vegetation*

Vegetation	Deer mice				Pocket mice				Harvest mice			
	1966		1967		1966		1967		1966		1967	
	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall	Summer	Fall
Native only	10	24	0	2	2	6	0	5	1	0	0	0
Introduced + native	1	10	0	5	3	9	0	3	22	21	0	0

DISCUSSION

We don't know to what extent weather may have been responsible for lack of substantial fall increases in numbers of mice on the heavily and moderately grazed units in 1967. However, precipitation totaling 4.1 inches during May and June, 1967, was considerably higher than the 1.1 inches for the same period in 1966, and also higher than the long term average of 1.99 inches for these two months. Blair (1948) reported that above-average rainfall during April, May, and June had an adverse effect on small mammals in Michigan. He suggested that above-average rainfall causes flooding of nest sites. Our data indicated that the breeding season at Benmore may be at a peak during April, May, and June, which encompassed the period of relatively high rainfall.

Pocket mice were seemingly least affected by factors that caused a general decline in densities of mice in 1967. These mice are known to undergo periodic torpor in response to low food supplies and/or low temperatures (Bartholomew and Cade 1957; Tucker 1962). They also become less active during winter months (Scheffer 1938). This ability of pocket mice to "remove" themselves from periods of environmental stress may explain, in part, why they appeared to be least affected by those factors responsible for the generalized decline in 1967.

Deer mice were caught most frequently in heavily grazed areas and areas with the least amount of cover. Other investigators have presented data suggesting that various species of *Peromyscus* avoid and may be at some disadvantage in areas of abundant cover (Hooper 1939; Andrewartha and Birch 1954; LoBue and Darnell 1959). Dambach (1944) found *Peromyscus leucopus noveboracensis* (Fischer) to be commoner in the grazed than in the ungrazed woodlands of Ohio.

Deer mice eat numerous kinds of arthropods and a wide variety of plant material (Jameson 1952; Williams 1959; Johnson 1961; Frischknecht 1965). Whitaker (1966) found lepidopterous larvae to be the ". . . single most important food throughout the summer and fall." Some studies have shown that insects increase where grazing is heavy (Smith 1940a, 1940b). This may explain, in part, the abundance of these mice in heavily grazed sites in the study area.

Harvest mice were noticeably rare in the nongrazed native grasses which were generally shorter than the introduced grasses on the adjacent area (fig. 2). Since these mice nest essentially above ground (Smith 1936; Hooper 1952), habits of growth of grasses and patterns of accumulation of litter would appear to be important factors for their success. Other investigators have found these mice to be associated with heavy plant cover (Blair 1943; Fautin 1946; Verts 1960; Brant 1962). From available information on food habits of harvest mice, it appears that seeds are the most important item in their diet plus considerable quantities of arthropods when available (Smith 1936; Johnson 1961). Of course, in addition to taller cover, seed production of the introduced wheatgrasses was much greater than that of most native grasses.

Pocket mice were most abundant in the nongrazed area where there was a mixture of seeded and native grasses and where cover and seed production were heavier than on any other site. Examination of the contents of cheek pouches of 33 pocket mice from all areas showed that seeds of grasses were the commonest food taken. Studies of pocket mice food habits by various workers have revealed a diet consisting primarily of seeds, especially those of grasses (Scheffer 1938; Johnson 1961). However, Jameson (1954) found insect remains to be common in a sample of 18 *P. parvus* taken in California in April. Other workers have found grazing to be detrimental to four other kinds of pocket mice (Quast 1948; Reynolds and Haskell 1949).

The study suggests that seeding programs increase pocket and harvest mice numbers where subsequent grazing by cattle is of light intensity. In contrast, seeding programs increased numbers of deer mice where utilization of forage by cattle was heavy. No correlation is evident between relative abundance of any rodent and species of grass.

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